Lab 4: Galaxy Classification

February 14, 2022

Answer Key

1 Introduction: In a Galaxy Far, Far Away

2 Classifying Galaxies

2.1 Make Your Own Classification System

1. In your lab book, write out a series of steps or a visual representation of how your method works. Make sure it is clear enough that someone else can use it.

2. Once you've finished writing, find the Hercules Cluster image under Files on Courseworks. Using your method, classify each labeled galaxy. How robust is your system? Comment, in your lab notebook, on what, if any, faults your method may have. Would it still be useful for images in X-ray or radio? Thinking a little about our previous lab 'The Multiwavelength Universe' will help you answer this question.

3. Now we will get together as a class, discuss the different classification systems you came up with, and come to a consensus for how to classify galaxies.

   Grade on clarity of system and ability to follow and classify Hercules Cluster galaxies. Do they recognize faults? Useful in X-ray and radio?

2.2 Galaxy Zoo

Spend about 10-15 minutes classifying galaxies on Galaxy Zoo and do the following for each galaxy that you see.

1. In a table in your lab notebook, keep a tally of how many galaxies of each type you see using the classification system we came up with in class.

2. Answer the questions that you are asked in Galaxy Zoo.

Once 10-15 minutes are up, in your lab notebook, **briefly reflect on anything unusual you saw and how it might make using the classification system we came up with as a class difficult. How could we improve our class classification system?** Grade on completion of Galaxy Zoo, reflection on difficulties with class classification system. What are some improvements?

3 Cue the Music - The Hubble Tuning Fork

1. There are 3 branches on the tuning fork. Describe what features you think each branch is representing, and how the galaxies along each branch differ. Grade on clarity of explanation

- Ellipticals grow in size, spirals are barred or unbarred, have looser arms and a larger bulge along the scheme.

2. How does the Hubble Tuning Fork compare with the galaxy classification system we came up with in class? Grade on comparison

3.1 The Hubble Ultra Deep Field

Do the following in your lab notebooks:

1. With the exception of a few stars in this image, every object you see is a galaxy. Try to identify the stars. How did you identify them? Have crosses on them/point spread function
2. Estimate the number of galaxies you see in the Hubble Ultra Deep Field. Grade for reasonableness of calculation. about 10,000
3. Does these seem reasonable, weird, outrageous? About what fraction are spiral galaxies? What fraction are elliptical galaxies? Grade for reasonableness of calculation.
4. Why are some galaxies larger than others? Closer, physically larger, more stars/light

4 Observing

Now, we will go look at our very own set of galaxies using the telescope. **In a table in your lab notebook, take down some observations for each galaxy we look at.** You may want to consider the galaxy's morphology (use the Hubble Tuning Fork), whether or not it is facing us or if it is edge-on, any unique or distinct features, etc. If you are finding it difficult to classify the galaxies, **why**?

Grade for completion, might be difficult to classify due to resolution of images, orientation of galaxy, non-consistent galaxy shape.

5 Conclusions

1. Considering the wide variety of galaxies that you saw in the Hubble Ultra Deep Field image, what are some other features of galaxies we could account for, besides morphology?
2. What might make classifying a galaxy difficult?
3. Do you have any feedback about this lab?
4. There is nothing to complete for this item, however, there are many citizen science research projects like the Galaxy Zoo that YOU can participate in. Check some of them out here: https://www.zooniverse.org/projects?discipline=astronomy&page=1&status=live